Chapter 7
EVERGLADES AGRICULTURAL AREA

PHYSICAL CONDITIONS - EVERGLADES AGRICULTURAL AREA (EAA)

The lands located immediately south and southeast of the Lake Okeechobee in the South Florida Water Management District (SFWMD or District) are known as the Everglades Agricultural Area (EAA) (**Figure 6**). This area of about 700,000 acres consists of rich, fertile agricultural land. A large portion of the EAA is devoted to the production of sugarcane. The average ground elevation is about 12 feet. The occurrence of surface water in the area is now a direct result of the construction of the numerous conveyance and drainage canals. The primary canals consist of the Miami, the North New River, the Hillsboro and the West Palm Beach canals, which traverse the area north to south, and the Bolles and Cross canals, which extend east to west. Water levels and flows are stringently manipulated in the canals to achieve optimum crop growth.

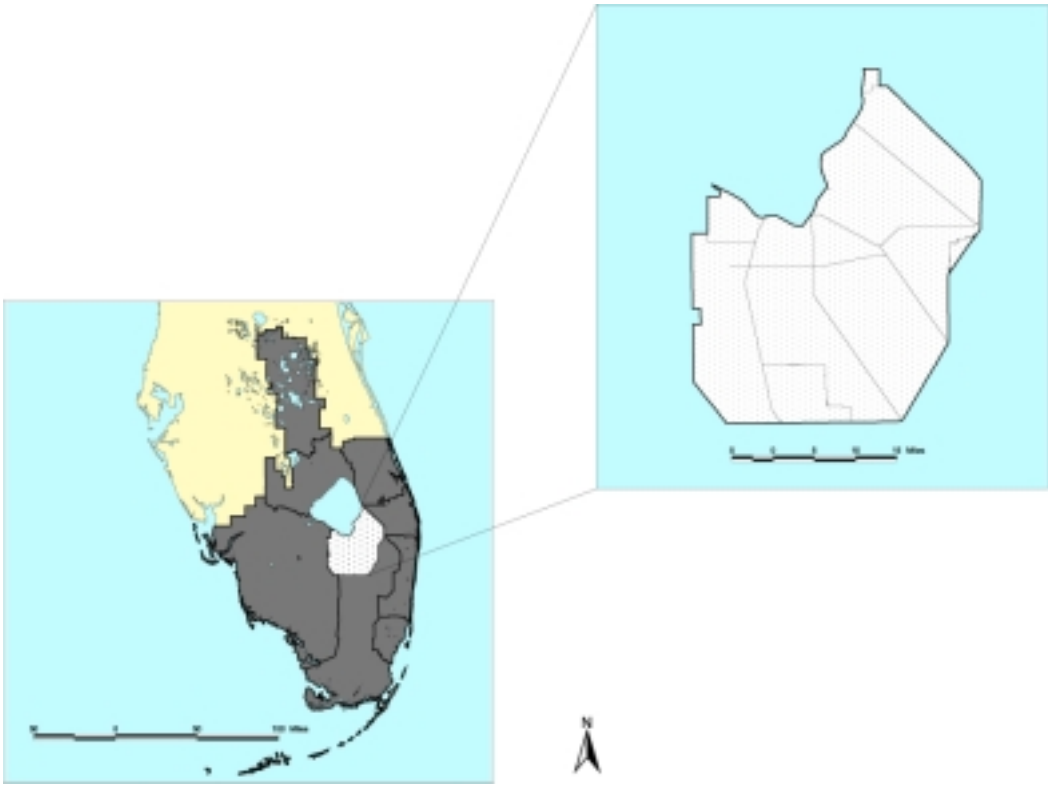

Figure 6. Everglades Agricultural Area (EAA).

EXISTING CONDITIONS - EVERGLADES AGRICULTURAL AREA (EAA) WATER MANAGEMENT

The existing drainage/irrigation system within the EAA is a complicated network of canals, levees, control structures and pumps. The original six major canals, (West Palm Beach, Hillsboro, Miami, North New River, Cross and Bolles canals), built in the 1920s, still serve to drain the EAA although each canal underwent major improvements during the 1960s. Historically the EAA has depended upon the flood storage capacity of Lake Okeechobee to the north and the Everglades Water Conservation Areas (WCAs) to the south as a means of removing excess drainage water from the EAA. Prior to adoption of the Interim Action Plan (IAP) in 1979, the northern one-third of the EAA was routinely backpumped directly into Lake Okeechobee through the S-2, S-3 and S-4 pump stations located on the south shore of the lake. The eastern and southern two-thirds of the EAA drained water south to the WCAs via pump stations S-5A, S-6, S-7 and S-8.

Under the current IAP, drainage from the S-2 and S-3 basins is now also routed south to the WCAs. Approximately 82 percent of the EAA land area (i.e., S-2, S-3, S-5A, S-6, S-7 and S-8 basins) now pump excess drainage waters into the three WCAs via pump stations S-5A, S-6, S-7 and S-8. Nine much smaller Chapter 298 Drainage Districts also currently discharge surface water runoff into Lake Okeechobee. As a result, the EAA depends on the flood storage capacity of the WCAs, and to a lesser extent, on Lake Okeechobee, as a means to remove water from the basin.

The growers remove runoff water from their lands by pumping to the six Central and Southern Florida Flood Control Project (C&SF Project) canals serving the EAA. Growers in general are allowed a maximum removal rate that is determined by a runoff formula and is almost always in excess of the basinwide design rate of three-quarters of an inch of runoff per day (Cooper, 1989). This amount was based on the following three considerations:

1. Not all land in the basin would be in agricultural production at one time.
2. Some of the land would be planted to water tolerant crops.
3. The canals in the basin have some storage capacity.

Although the capacity of the canal system is not large enough to handle all the water discharged from the EAA at one time, it was assumed that not all of the growers' pump stations would be pumping or pumping to capacity at any given time (Cooper, 1989).

FUTURE WITHOUT PLAN CONDITION - WATER QUALITY - EVERGLADES AGRICULTURAL AREA (EAA)

Recent monitoring results indicate that phosphorus loads in EAA runoff have declined approximately 51 percent (three year average, SFWMD, 1997b). The current average concentration of total phosphorus contained in EAA runoff is approximately 100

parts per billion (Havens, 1997). Construction of the Everglades Construction Project (ECP) involves converting approximately 44,000 acres of existing agricultural land into stormwater treatment areas (STAs). The construction project is explained in more detail below.

Everglades Forever Act (EFA)

The Everglades Forever Act's principal water quality treatment strategy for improving water quality in the Everglades Protection Area centers around five requirements: the ECP, EAA best management practice (BMP) programs, Everglades research and monitoring program, evaluation of water quality standards and long-term compliance permits.

The ECP consists of six large wetlands treatment facilities, or STAs, containing approximately 44,000 acres of land previously used for agricultural purposes. These areas are designed to treat EAA runoff prior to discharge into the Everglades Protection Areas.

The ECP is designed to treat EAA runoff to meet an interim phosphorus concentration target of 50 parts per billion in discharges to the Everglades Protection Area (Burns and McDonnell, 1994). STAs 1 East and 1 West will discharge into the L-7 and L-40 borrow canals in the Loxahatchee National Wildlife Refuge (WCA-1). STA 2 will discharge to WCA-2A via the L-6 Borrow Canal. STA 3/4 will discharge to WCA-3A via the L-5 Borrow Canal. Stormwater Treat Area 5 will discharge to Rotenberger and Holey Land Wildlife Management Areas and WCA-3A along the L-4 Borrow Canal. STA 6 discharges to WCA-3A through the L-4 Borrow Canal. STA 6 Section 2 will discharge to Rotenberger Wildlife Management Area. The future base condition assumes all of the treatment areas are completed and operational with the exception of STA 6 Section 2. STA 6 Section 2 was not included in hydrologic regional modeling since the conceptual design for the STA did not include this element (Burns and McDonnell, 1994).

Another component of the ECP targeted for completion in 2003 is the diversion of runoff from five special districts (four chapter 298 districts and the 715 Farms Area established under Florida Statutes). These special districts are located adjacent to Lake Okeechobee north of the EAA. Currently, the districts discharge directly to Lake Okeechobee. According to the EFA, approximately 80 percent of the historic flow volumes and total phosphorus loads are to be diverted away from the lake. The future base condition assumes that the diversion of flows and loads has been completed.

According to the EFA, based upon research, field-tests and expert review, the EAA BMPs are determined to be the most effective and practicable on-farm means of improving water quality to a level that balances water quality improvements and agricultural productivity. The act establishes monitoring programs, permit requirements, research, field-testing and evaluation programs designed to improve water quality prior to discharge into conveyance canals in the EAA. The act provides a tax incentive for phosphorus concentration reductions of 25 percent or more. As a consequence, the future base condition assumes a 25 percent phosphorus concentration reduction from BMPs.

In addition to the ECP and BMPs, the EFA directs that an Everglades Research and Modeling program shall seek means of optimizing the design and operation of the STAs. This program shall include research to reduce outflow concentrations and identify other treatment and management methods and regulatory programs that are superior to STAs in achieving the intent and purposes of the EFA. The research and monitoring program is also directed toward development of a permanent (threshold) phosphorus criterion in the Everglades Protection Area by the Florida Department of Environmental Protection (FDEP) and evaluation of existing state water quality standards applicable to the Everglades area. The criterion is to be adopted by December 31, 2003 or a default criterion of 10 parts per billion total phosphorus will be established. Currently, research efforts have not drawn any conclusions that affect treatment area designs, planned operations or the threshold phosphorus criterion. Research to determine superior or supplemental technologies and the threshold phosphorus standard is ongoing.

The EFA does specify that compliance with water quality standards shall be based upon a long-term geometric mean of concentration levels to be measured at sampling stations reasonably representative of receiving waters in the Everglades Protection Area. Discharges to the Everglades Protection Area from outside the EAA (non-ECP structures) also require evaluation to determine appropriate strategies. The EFA requires the SFWMD and the FDEP to take such action as may be necessary so that water meets state water quality standards in all parts of the Everglades Protection Area.

The EFA further directs that long-term compliance permit requirements shall be modified to achieve compliance with the phosphorus criterion cited in the above paragraph. If the FDEP has not adopted this criterion by rule prior to December 31, 2003, then the phosphorus criterion shall be 10 parts per billion in the Everglades Protection Area. This default criterion or the criterion adopted by the Department (Phase II) is to be imposed by 2006. The EFA specifies that as of December 31, 2006, no permittee's discharges shall cause or contribute to any violation of water quality standards in the Everglades Protection Area. In view of the fact that the Phase II phosphorus criterion has not been established, the future base condition assumes that the default standard of 10 parts per billion has been attained.

Design of the ECP was initiated in 1995 and began construction in 1997. STA 6 Section 1 was completed in October 1997 and operation was initiated in December 1997. Stormwater Treatment Area 2 was completed in June of 1999 and STA 5 was done in December of 1998. Construction of STA 1 West was finished in February 2000. Completion of STA1 East is expected to be done by June of 2004 and STA 3/4 is scheduled for completion by September 2004.

A demonstration-scale wetlands treatment area project of nearly 3,800 acres has been operating adjacent to WCA-1 (Loxahatchee National Wildlife Refuge) on the same site as future STA 1 West since 1994. STA 1 West will encompass the demonstration project when completed. The Everglades Nutrient Removal Project (ENRP) was designed to reduce phosphorus from an inflow concentration of 190 parts per billion to an outflow concentration of 50 parts per billion. The settling rate constant for the demonstration project was set at 10.2 meters per year. These were the same parameters established for

the ECP STA design. Three years of cumulative data from the demonstration project reflects that these criteria have been significantly exceeded. Additionally, on-farm BMPs have averaged 51 percent, considerably higher than the projected 25 percent contained in the future base condition for the EAA.

It is too early to predict what conclusions research and analyses will drive with regard to the above findings. An optimistic scenerio is that the BMPs reduction in phosphorus concentrations will increase STA operations such that concentrations lower than the interim criterion will be achieved. Also, the higher settling rate constant and low phosphorus concentration outflows could significantly improve performance of the STAs and thus reduce Phase II treatment needs. Only time and further operations of the treatment areas will judge whether the long-term findings will be supportive of the optimism suggested by current BMPs and ENRP findings. The current findings certainly should affect the research into what supplemental technologies may be necessary to achieve the Phase II phosphorus criterion.

During the alternative development and evaluation phase of the Restudy, a preliminary study was conducted by Walker (Walker, 1998) to evaluate the performance of the STAs based upon Restudy generated flows from the South Florida Water Management model in the future base condition and the preferred alternative. A phosphorus removal model developed by Walker was used in the study. Modeling results indicated that some of the STAs did not meet the interim phosphorus criteria of the EFA under either the future base condition or the preferred alternative. A closer examination reveals some of the reasons for the apparent underachievement. First, the periods of records differ. The ECP used a 10-year period of record from 1979 to 1988. The Restudy uses the 3 year period from 1965 to 1995. Second, the operational concepts differ. The Restudy uses rain-driven operational procedures whereas the ECP uses the current calendar-based regulation schedule. Third, because STA 6 Section 2 was not modeled in the Restudy, the treatment area was not considered in the phosphorus modeling. Therefore, a treatment area totaling nearly 2,000 acres was not considered and the inflows scheduled for this area were all routed through STA 5. Finally, although the period of record was changed from ten years to 31 years, the fixed parameters of the settling rate of 10.2 meters per year and targeted outflow concentration of 50 parts per billion remained unchanged from the ECP.

These two parameters (settling rate constant and outflow phosphorus concentration target) are two of the three most significant factors in determining the required area of treatment cells. Walker's study did indicate that when the 51 percent BMP phosphorus reduction rate experienced over a three-year period was used in lieu of the 25 percent estimate, all STAs met or bettered the interim phosphorus criterion with the exception of STA 5. STA 5 did not meet the criteria in the modeling outcome due to the third reason cited in the preceding paragraph.

At first blush, the reasons cited above appear to mitigate the Walker findings of STA underachievement. Although only time and continued operation of the treatment areas will provide proof, the findings should, in any case, direct research efforts toward ensuring that Phase II treatment technologies are sufficient to meet the adopted threshold

standard. Regardless of the Walker study or the demonstration project findings, the fact remains that the Phase II (threshold) phosphorus standard must be met by 2006. The default criterion of 10 parts per billion is the target assumed in the 2050 future base condition. At that point, the interim standard becomes obsolete. When research efforts determine the optimal method of operation and supplemental technologies needed to meet the EFA permanent (Phase II) phosphorus criterion, both the ECP and treatment elements of the Restudy components must be modified to attain the designated water quality standard.

WATER QUALITY PROBLEMS AND OPPORTUNITIES - EVERGLADES AGRICULTURAL AREA (EAA)

According to the FDEP 1998 303(d) list of use-impaired water bodies, there are approximately 10 canal segments within the EAA not meeting designated uses for Class III waters. For the most part, these include canal segments affected by operation of the primary pump stations and canals discharging water from the EAA to downstream areas (e.g., S-7 and S-8 pump stations; North New River, Hillsboro and West Palm Beach canals). In addition to excessive nutrient loads, low dissolved oxygen (DO) levels and high levels of mercury (based on fish consumption advisories), coliform bacteria, total suspended solids (TSS), turbidity and unionized ammonia contributed to use impairment in Class III waters within the EAA. It should be noted that within the EAA, there are many agricultural canals or ditches in agricultural water management systems controlled by water control structures permitted by the SFWMD. Such water bodies are classified as Class IV waters (agricultural water supply) pursuant to Rule 62-302.600(3)(a), Florida Administrative Code (F.A.C.). Generally, the water quality criteria for Class IV waters are less stringent than those for Class III waters. None of the 303(d)-listed segments within the EAA are in Class IV waters.

Water quality conditions within the EAA are expected to improve in 2050 compared to existing conditions. It is important to note that the existing conditions for the EAA demonstrate significant water quality improvements compared with recent past conditions. Recent water quality improvements in the area have occurred as a result of the implementation of the EAA regulatory program (F.A.C. Rule 40E-63) beginning in 1993. The regulatory program requires BMPs and monitoring to achieve a 25 percent reduction in phosphorus loading from the EAA to the Everglades Protection Area. Recent monitoring results indicate that phosphorus loads in area runoff have declined approximately 59 percent (SFWMD, 2003). The current average concentration of total phosphorus contained in EAA runoff is approximately 92 parts per billion (SFWMD, 2003). BMPs are also expected to have resulted in a net reduction of other pollutants contained in agricultural runoff, although the extent of load reduction for other pollutants has not been fully quantified since the implementation of the program; nor is it a specific objective of that program.

LAND USE - EVERGLADES AGRICULTURAL AREA (EAA)

Agriculture

The EAA contains all or parts of Palm Beach and Hendry counties. Most of Hendry County lies within the Big Cypress Region, so it was discussed in that section of the report. More than 600,000 acres are farmed in Palm Beach County (UFBEBR, 1995), and sugarcane was harvested from about half of that acreage in 1996 (FASS, 1996d). Sugarcane receipts accounted for 68 percent of total field crop sales in Florida in 1996 (FASS, 1996c). The EAA is known for its sugarcane production and sugar processing, but Palm Beach County also ranks fifteen among Florida counties for acres of citrus (FASS, 1996b). This region is characterized by midsize farms averaging 690 acres each with high productivity of more than $1,300 per acre (UFBEBR, 1995). More than 18,000 people are employed in agricultural production and services representing a payroll of more than $26 million (UFBEBR, 1995). Total market value of agricultural products in Palm Beach County is almost $900 million, ranking it first among counties in the state of Florida (UFBEBR, 1995) and third among United States counties (FDACS, 1994).

The EAA is highly dependent upon the system of canals running through the region to provide necessary drainage of excess water during the wet season, as well as supplemental water supplies for irrigation during the dry season. Approximately two thirds of the land farmed in the EAA is irrigated, totaling more than 580,000 acres (B. Boyd, pers. comm.). The EAA has traditionally relied upon Lake Okeechobee for its water supply, and looked to the WCAs to the south to receive their excess drainage.

Continued agricultural production in the EAA has become increasingly controversial. Some of the factors that may affect EAA agriculture include water quality concerns, soil subsidence and encroachment of urbanization. The water quality concerns, particularly phosphorus loading, are being addressed through implementation of BMPs, construction of STAs, the growing use of organic farming practices and rice cultivation in rotation with sugarcane production.

Palm Beach County is included in this region. A portion of Hendry County also lies in the EAA. Palm Beach County is not entirely within the EAA, but it is assumed that the majority of agricultural production is within the EAA because the remaining portion of the county is primarily urbanized.

Although sugarcane cultivation in the EAA has come under some sharp criticism in recent years, sugarcane is recognized as the most appropriate crop for this region. Sugarcane requires less phosphorus fertilizer than other crops grown in the EAA (Sanchez, 1990), and sugarcane has been found to remove 1.79 times more phosphorus than was applied as fertilizer (Coale et al., 1993). Florida sugarcane only requires small amounts of pesticides due to disease resistant and tolerant cultivars, and cultivation instead of herbicides for weed control. Sugarcane also tolerates greater variability in water table levels, allowing for more flexible water management strategies (Glaz, 1995).

Soil subsidence has become a potential threat to long-term crop production in the EAA. The average historic rate of subsidence of 1 inch per year has slowed to 0.56 inches per year since 1978 (Shih et al., 1997). They attributed the lower rate to several factors including higher water tables and an increased proportion of land planted to sugarcane. Surveys conducted by Shih et al. (1997) in 1997 found an average of 1.62 feet to 4.36 feet of soil remaining over 11 transects. Prevention of continued soil subsidence will depend on maintaining high groundwater levels to prevent further oxidation of the soil profile. This, in turn, will require development of more water-tolerant sugarcane varieties and/or increased rice cultivation. This research is currently underway and showing promising results (Glaz, 1997). A strong agricultural economy in the EAA based on profitable crop production is the best defense against conversion of agricultural land to urban land.

Rotenberger and Holey Land Wildlife Management Areas

The Holey Land Tract (35,026 acres) is managed by the Florida Fish and Wildlife Conservation Commission (FWC) as a state wildlife management area. The SFWMD has been managing the hydroperiod since completion of a perimeter levee and pump station in 1990. The Rotenberger Tract (23,970 acres) and Brown's Farm Tract (4,460 acres) are also managed by the FWC as state wildlife management areas. Lake Harbor Waterfowl Management Area is operated by FWC for management of waterfowl. The land is under rice production for both harvest and wildlife habitat.

Urban

The remaining five percent of the EAA includes the communities of Pahokee, Belle Glade, South Bay and Clewiston, along with several sugar mills, roads, canals and water control features.

C-139 Basin

Land use within the C-139 Basin of eastern Hendry County is predominantly agricultural. The land use in the basin is approximately 62 percent agricultural, 4 percent urban and 34 percent native land cover. This rural area is primarily pasture land for cattle grazing, with increasing amounts of land being converted to citrus groves. Agricultural land uses include vegetable farms, citrus groves, improved pasture and unimproved pasture (Mock Roos, 1993).

ELIGIBLE COMPREHENSIVE EVERGLADES RESTORATION PLAN (CERP) PROJECTS

Everglades Agricultural Storage Reservoir Project - Part 1

This project is the first part of the of the Everglades Agricultural Area Storage Reservoir component. It includes two aboveground reservoirs with a total storage capacity of approximately 240,000 acre-feet located on land associated with the Talisman Land

purchase in the EAA. Conveyance capacity increases for the Miami, North New River, Bolles and Cross Canals are also included in the design of this project. This project will improve timing of environmental deliveries to the WCAs by reducing damaging flood releases from the EAA to the WCAs, reducing Lake Okeechobee regulatory releases to estuaries, meeting supplemental agricultural irrigation demands and increasing flood protection within the EAA. More detailed information is available on www.evergladesplan.org.

Loxahatchee National Wildlife Refuge Internal Canal Structures

This project includes two water control structures in the northern ends of the perimeter canals encircling the Loxahatchee National Wildlife Refuge (WCA-1) located in Palm Beach County. The purpose of this project is to improve the timing and location of water depths within the Refuge. It is assumed that these structures will remain closed except to pass STA 1 East and STA 1 West outflows and water supply deliveries to the coastal canals. More detailed information is available on www.evergladesplan.org.